

Maritime Trade of Classical Greece: Commodities Shipped in Transport Amphorae

by

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Author's Declaration

I hereby declare that I am the sole author of this thesis. This is a true copy of the thesis, including any required final revisions, as accepted by my examiners.

I understand that my thesis may be made electronically available to the public.

Abstract

Trade practices have long been a concern of anthropological studies but has fallen out of focus in archaeological research. Much can be learned about trade from material remains, especially those from shipwrecks. For this study, material remains from four Classical Greek merchant shipwrecks will be examined to identify commodities contained within transport amphorae. This research will provide insight into commodities that are well-known for this historical context, such as wine and olive products, in addition to other commodities not often discussed or even known about. Furthermore, this will highlight the need for archaeological research to engage with anthropological practices of studying trade.

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Table of Contents

Author’s Declaration.....	ii
Abstract	iii
Acknowledgements.....	iv
List of Figures	vii
List of Tables.....	viii
Chapter 1 Public Issues Anthropology.....	1
Chapter 2 Analysis and Discussion of Transport Amphorae Contents.....	5
2.1 Anthropological studies of trade and exchange	5
2.2 Why do we study trade?.....	6
2.3 How do archaeologists study trade?.....	7
2.4 Studying maritime trade in archaeology	9
2.5 Introduction to Classical Greece	10
2.6 Trade in Classical Greece.....	11
2.6.1 Discussions in archaeology	11
2.6.2 Mobility and trade	13
2.6.3 Transport amphorae	15
2.7 Classical shipwrecks	18
2.7.1 Tektaş Burnu (Turkey).....	19
2.7.2 Porticello (Italy)	20
2.7.3 Mazotos (Cyprus).....	20
2.7.4 Kyrenia (Cyprus).....	21
2.8 Material evidence from wrecks.....	21
2.8.1 Tektaş Burnu (Turkey).....	21

2.8.2 Porticello (Italy)	25
2.8.3 Mazotos (Cyprus).....	28
2.8.4 Kyrenia (Cyprus).....	31
2.9 Analysis.....	33
2.9.1 Wine	34
2.9.2 Olives/olive oils/plant-based oils	36
2.9.3 Pine tar	38
2.9.4 Almonds	38
2.9.5 Other possibilities.....	40
2.10 Discussion	41
References	48

List of Figures

Figure 1: Map of the Mediterranean Sea with markers of shipwrecks in this research.....	19
Figure 2: Map of Tektaş Burnu shipwreck location and where cargo possibly came from.....	22
Figure 3: Map of Porticello shipwreck location and where cargo possibly came from.....	25
Figure 4: Map of Mazotos shipwreck location and where cargo possibly came from.....	29
Figure 5: Map of Kyrenia shipwreck location and where cargo possibly came from.....	31

List of Tables

Table 1: Amphora types present in this study.....	16-18
Table 2: Summary of transport amphorae excavated from Tektaş Burnu wreck.....	21-22
Table 3: Summary of transport amphorae excavated from Porticello wreck.....	25
Table 4: Summary of transport amphorae excavated from Mazotos wreck.....	28
Table 5: Summary of transport amphorae excavated from Kyrenia wreck.....	31
Table 6: Summary of commodities found at each wreck site.....	34
Table 7: Wine amphora capacity summary.....	35

Chapter 1

Public Issues Anthropology

Trade is integral to the economic function of the modern world. If you walk into any store, whether for food, appliances, or clothing, your purchase will most likely be labeled as having been imported from another country. For example, much of the produce found in a Canadian grocery store comes from countries nearer to the equator; many of the prices for these goods soar during the winter months, as Canada cannot supplement with produce from Canadian farms. Trade is known to occur over vast distances both now and in the past, with many products nowadays being transported halfway around the world to reach an ultimate destination (Altman & Bastian 2023). Without trade, many people worldwide would not have access to commodities often taken for granted.

Several modalities and systems support supply chains to keep them running. Often, supply chains utilize various methods of movement, from air to sea to rail, to ensure commodities reach a destination (Hoffer 2015:4). However, none of them is risk-free (Hoffer 2015:5). Those who directly engage with the management of supply chains must take into consideration all of the moving parts that keep the chain going, as the breaking of one of these links causes the chain to cease. When a supply chain, and thus trade, is disrupted, it is incredibly noticeable; it has become even more noticeable in recent years due to several events around the world.

In March 2020, the World Health Organization (WHO) declared a global pandemic with the spread of the COVID-19 virus. The year was reported to have “the largest reductions in trade and output volumes since World War II,” although statistical evidence shows trade as having recovered relatively quickly before the end of the year (OECD March 10 2022). During this disruption, there were dramatic shifts in which items were sought after; there was an increased demand for medical products and food and a decreased demand for items such as fuel and mechanical machinery (OECD March 10 2022). Even COVID-19 vaccines needed to be imported to Canada from foreign

pharmaceutical companies producing the vaccines (Government of Canada n.d.). The pandemic led to the rapid decrease and increase of product availability in supply chains, with researchers continuing to examine the consequences of the more-than-two-year period.

Other events during the pandemic exacerbated the mass media interest in trade. In March 2021, the Suez Canal made headlines when the *Ever Given*, one of the largest shipping vessels in the world, blocked the waterway for six days, leading to upwards of 400 ships being backlogged in the canal (Berger et al. 2021; Russon 2021; Schwartz 2021). The event caused more than \$9 billion in lost costs (Berger et al. 2021; Russon 2021), with transport ships facing delays either by waiting for the *Ever Given* to be refloated or by taking a dangerous eight-day detour around the Cape of Good Hope in the south of Africa (Berger et al. 2021). The Suez Canal is a crucial route for maritime trade between the Red Sea and the Mediterranean Sea and has been since opening in 1869 (Berger et al. 2021). Since the event, many have speculated whether trade routes can keep up with the increase in demand in the supply chain, especially with the construction of ships even larger than the *Ever Given* becoming more common (Schwartz 2021), and thus more likely to face similar issues as this obstruction event.

In 2022, Russia invaded Ukraine, leading to an ongoing crisis in the Eastern European countries. Russia and Ukraine provide grain and sunflower oil to many countries, together accounting for 36% of the world's wheat exports before the war broke out (Kilfoyle 2023). While the war itself has been devastating for those living in Russia and Ukraine, it has also impacted developing economies which rely on importing these products (Kilfoyle 2023), leading to food insecurity for millions (Zheng et al. 2023). In July 2022, the two countries came to an agreement with the Black Sea Grain Initiative, with Russia allowing Ukraine to resume trade activities, though Ukraine mainly exported to wealthier countries in an attempt to receive more revenue (Kilfoyle 2023); unfortunately,

Russia officially backed out of the agreement in July 2023 (Kilfoyle 2023), meaning that Ukraine could no longer invest in exports to support their economy.

These are just a few recent events which have impacted trade and supply chains in the world today, and they will not be the last. Such disruptions have occurred throughout human history, leading to disruptions for populations who rely on trade to either receive foreign commodities or to support their economies through exports. While certain events can be unforeseen, we have a responsibility to engage with and learn from those we know of and how trade has been done in different historical contexts.

Unfortunately, not all of these historical events have left written records; as such, archaeology must engage with the topic to identify modes of trade and what commodities were included in the practice. Commercial development has been an economic phenomenon for thousands of years, with academics noting its potential presence in ancient economies of Greece and Rome (Smith 2004:77). Archaeologists can thus examine the commodities which contributed to this commercial development, examining where they came from, who would have used the items, and why they were part of supply chains of the ancient world. Such research can be done from various archaeological sites and contexts, though examining ancient shipwrecks allows for the greatest data output as they provide a snapshot of trade in action.

As previously stated, trade relies on many modalities, the one of the longest-standing of them being maritime transportation. In the context of ancient shipwrecks, or more specifically, ancient merchant shipwrecks, commodities were often carried in large quantities and shipped across seas over weeks or months. In research, archaeologists look at the material remains of these commodities and their containers to understand what products were of interest in trade for a given historical context (Greene 2018:133). Despite their effectiveness in expanding our knowledge of trading systems and

day-to-day products, research into shipwrecks often becomes sensationalized in news outlets and mass media for other knowledge they provide.

When talking about shipwrecks discussed in the news, many people think of the most famous ones, such as the *RMS Titanic* or, in recent articles, the Antikythera wreck. Such wrecks have been sensationalized and become infamous, leading to blockbuster movies being made based on the archaeological or cultural significance of the sites; *Titanic* has been featured in many films, most notably James Cameron's 1997 film (Marshall 2023), and the mechanism excavated from the Antikythera wreck was the focal artifact for *Indiana Jones and the Dial of Destiny* (Ritter 2023). However, the sites that are sensationalized and discussed most often are also anomalies; they do not, and cannot, represent the more common aspects of maritime transportation. As such, the public needs to become more aware of archaeological research engaging with shipwrecks outside of these sensationalized stories, looking instead towards the sites which provide insight into how the average person lived at another point in history. By engaging with archaeological research of supply chains and trade in the context of shipwrecks, the public can better understand how trade has always been part of how our world functions, as well as the continued necessity of a practice which is largely ignored by the average person.

Chapter 2

Analysis and Discussion of Transport Amphorae Contents

2.1 Anthropological studies of trade and exchange

Anthropologists have long been concerned with the study of economic systems and modes of exchange. Early work from anthropologists, most famously Bronislaw Malinowski and Marcel Mauss, pioneered anthropological research on exchange, gift-giving and reciprocity (Bauer & Agbe-Davies 2010:34; Lazzari 2010:50; Oka & Kusimba 2008:343). Within cultural anthropology, studies of economics thrived during the 1960s and 1970s, but since then, other topics have eclipsed studies of economic systems (Agbe-Davies & Bauer 2010:14; Smith 2004:83). However, as exchange practices continue to be integral to contemporary economic systems, we need to include them within anthropological studies.

Exchange can be understood as the simple transfer of things between groups (Agbe-Davies & Bauer 2010:15). It is not overtly social or economic, allowing a great many processes to be considered in studies of exchange, including intangible notions such as cultural diffusion (Bauer & Agbe-Davies 2010:30). A recent anthropological approach considers exchange to be a means of communicating and reinforcing socio-cultural values (Agbe-Davies & Bauer 2010:19), bringing forth an understanding of how any exchange practice is inherently a social activity (Agbe-Davies & Bauer 2010:13). Exchange can thus be considered an umbrella term for a variety of transactional practices, with trade being included as a category.

As a category of exchange, trade has additional connotations, being understood as a “more formalized and market-based” practice (Agbe-Davies & Bauer 2010:15). Trade involves the transfer of material goods, the tangible objects of interaction between groups (Oka & Kusimba 2008:352). As

a form of exchange, trade is a means by which groups can solidify their relationships for economic purposes (Agbe-Davies & Bauer 2010:19; Bauer & Agbe-Davies 2010:41). The term must be distinguished from its parent term of exchange, as the two examine different aspects of social interactions.

Scholars have previously noted that trade and exchange are often viewed on the same plane, as if the terms are one and the same (Summerhayes 2015:481). However, in examining the commodities of market-based interactions, the two must be separated. This research will consider aspects of trade as a specific form of exchange rather than equating the two as one singular term. Trade is considered more formal and structured than exchange (Agbe-Davies & Bauer 2010:15); thus, it focuses on how exchange practices contribute to and support past and present economic systems.

While the ethnographic findings of cultural anthropological research have largely informed understandings of trade, archaeologists have also brought the topic into the research focus. Archaeologists use material evidence to identify where trading practices may have occurred and between whom (Summerhayes 2015:482). As with the broader studies of economic systems in anthropology, archaeological research of trade was more prevalent during the 1960s and 1970s before its ultimate decline (Agbe-Davies & Bauer 2010:14; Smith 2004:83). For example, some scholars examined materials found outside of their regions of origin to identify trading practices and the movement of material goods, such as Colin Renfrew and his studies of obsidian trade in the Aegean (Renfrew et al. 1965:225).

2.2 Why do we study trade?

Since the decline of economic anthropology in the 1980s, in archaeology, there has been a continued accumulation of data without “conceptual sophistication” of said data (Smith 2004:84). In other words, while archaeologists continue to identify the materials they believe were involved in

trade, no culturally significant meaning is applied to the interpretation. In discussing the decline of archaeology of trade, Agbe-Davies & Bauer (2010:14) note the need to integrate themes of post-processual archaeology into discussions using evidence of materialist studies relating to trading activities. Essentially, archaeological research in this realm lacks an understanding of why trade occurred and how the remaining material evidence can provide an understanding of this.

Archaeologists must use material remains to answer questions regarding the reasoning for trade. Archaeological research has engaged with the objective need or value of an object, with the value of the object being determined by how practical or needed it is in a given historical context (Lazzari 2010:54). However, we must question the ultimate objectivity of this need or value; was the item being traded as a means of establishing or maintaining status? Was it something that could have been sourced locally, but instead was included in trade systems? By engaging in discussions regarding why trade took place and why an item was included in trading practices, archaeologists provide insight into how trade becomes more than just a form of exchange, stimulating economic growth and social interactions between groups.

2.3 How do archaeologists study trade?

In examining trading practices, archaeologists primarily rely on material remains as references or evidence. Artifacts must have specific characteristics for archaeologists to demonstrate and prove the presence of trade (Summerhayes 2015:482). There are a number of ways in which archaeologists can use these remnants of the past to contribute insight into discussions of trade.

Archaeologists may examine whether a material was found in its place of origin. A material may only naturally occur in specific regions; examples of this can be some types of stone or faunal remains from a geographically-restricted species. Using knowledge of where the material would come from, archaeologists can pinpoint whether an artifact was involved in movement potentially linked to

trade. For example, obsidian is noted as naturally occurring in areas of volcanic activity (Renfrew et al. 1965:225). When found in prehistoric sites of the Aegean islands and the Near East, archaeologists used the knowledge that obsidian does not naturally occur in the region to identify material movement; in this research conducted by Renfrew et al. (1965:241), archaeologists identified the material as having come from the island of Melos, located between the Peloponnese and Crete. Thus, our understanding of the natural origins of materials aids in identifying the import or export of a fabric.

To identify where an object was made, archaeologists examine the stylistic characteristics of the object. Different styles of production are linked to different regions and cultures (Grace 1979:9; Whitbread 1995:6-7), thus allowing archaeologists to identify where an object was made, regardless of the fabric's origin. Previous work in the field has provided insight into how styles are linked with specific regions and cultures. Greek amphorae, which will figure prominently in this research, are a good example. In examining the styles of amphorae from ancient Greece, archaeologists often look to established chronologies and typologies put forth by Virginia R. Grace (Grace 1979; Whitbread 1995:1), whose life work focused on categorizing styles of amphorae based on geographic or cultural origin and place in time. The distribution of a given style allows for the understanding of how far trade routes expanded at different points in history (Whitbread 1995:4). Using such data, archaeologists may identify an object as being made from an imported fabric or whether the style and fabric share origins.

In addition to examining the origins of material remains, archaeologists also look at the quantities of materials at a given site to identify the extent to which trade may have occurred in an area. The concentration of materials (i.e. the location and density) (Smith 2004:83) can indicate the potential demand for an object in trade markets, whether on a local scale or a more extensive one. For

example, the concentration of materials with “high levels of craft intensity” can indicate the presence of a highly commercialized society or state-control of materials in an uncommercialized society (Smith 2004:83). Quantitative data from archaeological sites serves the overall purpose of allowing for statistical analysis and comparison of materials (Agbe-Davies 2010:79), which in turn can indicate variations in the site and allow for more questions to be asked for a given material in a specific context. Therefore, it can be said that examining quantities of materials is a valuable tool in the study of trade in archaeological research.

2.4 Studying maritime trade in archaeology

Archaeologists studying trade can learn from every kind of archaeological site. However, shipwrecks provide a unique insight into the topic. Archaeological sites on land look at either the before or the after of the trading event; shipwrecks, on the other hand, provide a window into trade in action.

Shipwrecks can be considered in the lens of the Pompeii premise. A reconstructionist notion, the Pompeii premise is applied to archaeological sites as examining how they were in a moment stopped in time, as the Roman city of Pompeii was at the eruption of Mount Vesuvius (Binford 1981:196). Shipwrecks offer insight into what commodities were being transported aboard a given ship, being a snapshot of this particular moment in trade. However, they do not provide the overall historical or cultural context of what actors were involved in trade networks; archaeologists must consider the materials at a wreck site beyond the immediate deposit or concentration that makes up the site. While the Pompeii premise may seem to be fully epitomized in shipwrecks, it is not wholly accurate.

In examining what remains of these shipwrecks, archaeologists must use contextual evidence and knowledge to identify which materials were trade commodities (Greene 2018:133). It would be

simplistic and inaccurate to treat all artifacts as commodities, as crew's wares and similar items are part of the assemblages, which are hallmarks of the shipwrecks (Katzev & Swiny 2023:512). The organization of a shipwreck assemblage offers clues for whether an object was a commodity, as crew's wares were often located in a separate area of the ship than items intended for trade (Katzev & Swiny 2023:76). Identifying the materials as commodities rather than wares allows archaeologists to explore the role of the artifact in trade.

When examining early practices of trade, evidence strongly points to seaside cultures coming to rely on maritime transportation and becoming more mobile at sea (Broodbank 2016:19-20). Geographies of certain regions made terrestrial travel difficult, meaning that the use of ships and other watercraft was an essential tool for movement (Broodbank 2016:24). In examining trade, it is imperative to understand how people moved in general, making the study of shipwrecks in archaeology of trade essential. An instance where such studies would be most useful would be in ancient Greek studies, where mountainous terrains made terrestrial transport difficult. To identify trading practices of a specific time, we will examine shipwrecks from the Classical period in the Eastern Mediterranean and beyond.

2.5 Introduction to Classical Greece

The Classical period is marked by several famous events, such as the Greco-Persian War (Thomas 2014:67-71), the Peloponnesian War (Thomas 2014:60-63), and the rise and fall of Athens (Thomas 2014:55-57). "Greek" is often encompassed by culturally and linguistically related city-states in the Aegean Sea, with other territories across the Mediterranean being included in the term due to the maritime expansion of ancient Greek civilization (Thomas 2014:x-xi). The Classical period is usually identified as being 510-323 BC, with the end being noted as such for the change in the nature of archaeological evidence (Reed 2003:5) and the death of Alexander the Great (Thomas

2014:74). In their maritime expansions and facilitation of trade routes, Classical Greek artifacts are known to have made it as far as modern-day Spain (Whitbread 1995:5-6).

Many of the famous historical sites around modern-day Greece have been the subject of archaeological research ranging from the Bronze Age (3000-1050 BC) to the Ottoman Empire (1453-1821 CE) (Thomas 2014:v-vi). Examples from mainland Greece include the Acropolis and Agora at Athens, the Temple of Apollo at Delphi, and the cities of ancient Corinth and Mycenae. These sites are well-known for expanding our knowledge of how people lived thousands of years ago, providing insight into many aspects of life in these societies, including subsistence, social organization, and religion. Yet just as these famous terrestrial sites provide such valuable information, so do the sites not seen above sea level. The ancient Greeks were well-known for their maritime mobility, and there is a need to engage with the evidence found from the wreck sites that have been discovered and studied within archaeology.

2.6 Trade in Classical Greece

2.6.1 Discussions in archaeology

As trade is a fundamental part of economic studies, it must be considered when discussing ancient societies' economic structures, such as those of the Classical period. Research from the 1970s and 1980s often discusses how ancient societies functioned according to different economic models (Smith 2004:75; Summerhayes 2015:482), trying to identify whether they were early forms of contemporary market economies or fundamentally different forms of economies. These works, such as Karl Polanyi's *Trade and Markets in the Early Empires* (1957) and Moses Finley's *The Ancient Economy* (1973), discussed whether ancient Mediterranean economic systems aimed for subsistence or for economic growth. Such theories continue to be discussed within contemporary archaeological and classical research (Bresson 2016; Lawall 2015; Smith 2004; Summerhayes 2015), yet there are no

definitive conclusions regarding the ultimate goal of these systems. While archaeologists no longer examine economics and trade using these rigid categories, we must continue to engage in discussions of ancient trade systems to further understand how groups communicated with one another. As we have defined trade as a formal economic exchange, archaeologists must examine the commodities involved in trade regarding their role in stimulating ancient economies and facilitating relationships for trade.

Often, research into trade commodities of Classical Greece focuses on wine and olive oil, as these products were transported in high quantities throughout ancient Mediterranean history (Tzochev 2016:231). However, they often become the main source of discussion, overshadowing other materials that have also been interpreted as commodities by archaeologists. We must bring the focus back to identifying what materials from Classical shipwrecks are considered as commodities and why, rather than simply identifying wines and olive products as being the main commodities involved in trade. Discussion of all commodities, not just those that are sensationalized in news sources or regularly found in large quantities, will bring to light the ideas of how trade was an essential part of economic structures in the ancient world.

Furthermore, we must identify why these commodities were part of trading systems of Classical Greece. For example, wine is known to have been a commodity produced in a number of Greek city-states and settlements, yet wine from Chios was considered to be of high quality and thus sought after in trade structures (Briggs et al. 2022:781; Grace 1979:19; Maccius Plautus, *Curculio* 1.1.78, *Poenulus* 3.3.85). How did the quality of wine relate to its consumption as a commodity? Why would they import wine when it was relatively accessible across localities? Is there any sort of prestige attached to it? Additionally, some products were not available in all regions of the Mediterranean, and thus not available locally (Lăcătușu et al. 2019:3; Lawall 2016:260; Ulyaşer &

Yıldız 2014:1098), leading to the necessity of including them in trade. Such characteristics regarding cultural significance and local availability of commodities are further discussed in this research.

2.6.2 Mobility and trade

During the Classical period, materials were moved either by land or by water. As previously stated, movement over land was difficult over certain terrains (Broodbank 2016:24), and the mountainous regions of the Mediterranean were no exception. Roads were still available to transport goods over land (Bresson 2016:120), but there were several limitations to this mode of transportation. First, it was much more expensive (Bresson 2016:118). Mobility required a source of energy, and for land, this source was animals, such as oxen and mules, and travel could only be done in relatively shorter distances (Bresson 2016:120). Maritime transportation, on the other hand, relied on the constant winds in the Mediterranean, so there was always a source of energy for movement (Bresson 2016:118). Second, only a limited amount of material could be transported in a single trip (Bresson 2016:120). Oxen and mules could only pull so much weight, and carts would have much more limited space; in contrast, ships during this time could carry anywhere from 50 tons (Bresson 2016:125) to 500 tons (Kron 2015:360). These limitations, combined with the general proximity of the sea across the region (Bresson 2016:67), made maritime transportation the optimal mode of movement in Classical Greece.

It is well-known that, in ancient Greece, maritime travel took place primarily along the coast. Knowledge of navigating the waters of the Aegean Sea and the broader Mediterranean Sea was passed down through generations (Bresson 2016:128), with land markers usually being indicators of the ship's location. Ships would often go days at a time without landing, but they would still land at ports along a trade route to seize any opportunities for importing or exporting goods (Bresson 2016:129). Upon landing in these city-states, the owner of the ship would be required to pay a tax to

dock there (Bresson 2016:365), as well as additional taxes on any cargo which was unloaded during the stop (Bresson 2016:366); taxes would not have to be paid for merchandise which remained on the ship throughout the stop (Bresson 2016:366). This form of movement has been called a “cabotage” mobility (Kowalzig 2018:101), whereby ships would sail short distances from port-to-port, but would cover long distances overall. Travel by sea would take several days, though lengths varied depending on the winds and weather; for example, Bresson (2016:129) notes that sailing south from Byzantium to Rhodes could take approximately five days, while sailing north from Rhodes to Byzantium could take approximately ten days.

In the grand scheme of maritime trade in Classical Greece, there are a number of actors from whom to consider involvement. Overall, it seems that trade and other economic affairs were largely under community control (Bresson 2022:221); in *The Ancient Economy*, Finley notes a sort of apathy from the state regarding trade (Bresson & Harris 2015:42-43; Finley 1999:161-162, 164). The community ensured a division of labour (Bresson 2022:224), allowing producers to specialize in their field, thus leading to an increase in quantity and quality of an item (Bresson 2016:235). These specializations further allowed for a form of self-sufficiency to overtake city-states. Urban populations, such as craftsmen or merchants, would rely on food production from the countryside, while the rural population would purchase crafted and imported goods from the agora (Bresson 2022:224). As has already been discussed, however, not all goods were available locally, leading to the import of them instead. As city-states were not subsistence-based, surplus of goods would be exported by merchants to other city-states for trade (Aristotle, *Politics* 1.1257a; Bresson & Harris 2015:46). All citizens would have access to the necessities through the division of labour and its contribution to trade systems.

2.6.3 Transport amphorae

To identify trade commodities on ancient shipwrecks, archaeologists often look to transport amphorae for evidence. Transport amphorae are utilitarian vessels produced to transport liquids and semi-liquid goods (i.e. items which were not liquid but could easily be poured as if they were liquid), providing evidence for commodities shipped in them (Whitbread 1995:1). Amphorae are broadly characterized by their narrowed necks and vertical handles closing the amphora at the bottom with a toe (Whitbread 1995:1), though they come in a variety of shapes and sizes (Grace 1979:1). It is important to note that not all commodities transported in ships during the Classical period were transported in these amphorae; some may have been carried in burlap sacks (Katzev & Swiny 2023:369, 453; Whitbread 1995:23) or even loose in the hold. Furthermore, most of what we believe we know about transport amphorae comes from the interpretation brought forth by archaeologists, as in many cases, the commodity has deteriorated without leaving macro-remains.

Archaeologists may examine the amphora shape or chronology, or its interior walls, to infer what the amphora may have been used to carry. As the styles of amphorae are linked to specific geographical and cultural regions, archaeologists often infer the contents based on knowledge of what a group was known to produce. In the case of Chios, for instance, their amphorae are often assumed to carry wine (Briggs et al. 2022:781; Demesticha 2011:48); as well, for Punic amphorae, archaeologists may associate the amphorae with fish products such as garum (Eiseman & Ridgway 2012:48; Preusz et al. 2019:568). Additionally, amphorae are noted as having occasionally been lined, with specific instances of pitch (resin) (Carlson 2003:584) or pine tar (Katzev & Swiny 2023:367, 444). The terms “pitch” and “pine tar” are often used interchangeably, though they are different, as pine tar is highly toxic (Barnes & Greive 2017:82). For this research, the term “pitch” will be used to avoid confusion with the toxic substance of pine tar. Pitch would chemically react with contents of

the amphora to give a resinous taste to the product (Preusz et al. 2019:566-567), so some products were favorable to put in these amphorae.

Archaeologists must also consider whether amphorae have been re-used or contained mixed products. Amphorae are thought to have been in a continuous state of use and re-use (Lawall 2016:269), and contents are also thought to have been intentionally mixed in some cases (Briggs et al. 2022:780), such as grapevine products being mixed with honey or fruit juice (Briggs et al. 2022:793). Such mixes could involve the mixing of different quality wines (Lawall 2016:265) or the addition of herbs to an oil product (Hansson & Foley 2008:1175).

Production of transport amphorae is thought to have been standardized within respective city-states, allowing for the categorization of these amphorae according to their stylistic identifiers (Grace 1979:11; Whitbread 1995:9-10). Certain stylistic choices and amphora stamps are associated with certain regions or city-states (Grace 1979:11), allowing archaeologists to identify where the amphorae, and possibly their contents, came from. Furthermore, the stylistic choices of the standards changed over time (Grace 1979:11; Whitbread 1995:1), leading to the opportunity for archaeologists to use amphora chronology to date archaeological sites. Discussions of these styles are central to much of this research, as archaeologists typically identify potential commodities based on where amphorae came from and the construction of the amphora's shape or interior lining. *Table 1* provides a comprehensive list of named amphorae styles found at the Classical wrecks discussed in this research.

Table 1: Amphora types present in this study.

Amphora type	Geographical Origin	Found at which shipwrecks/sites	Additional notes	Citations
Pseudo-Samian	Unknown; possibly	Tektaş Burnu	-found at various archaeological sites in	Carlson 2003; Carlson 2013

	Erythrae?		the eastern Mediterranean and Aegean	
Rhodian	Rhodes	Kyrenia	-Rhodes known for wine exports	Katzev & Swiny 2023
Samian	Samos	Kyrenia	-Samos known for olive oil exports -Wine from Samos considered to be of lower quality	Katzev & Swiny 2023
Koan	Kos	Kyrenia		Katzev & Swiny 2023
Knidian	Knidos	Kyrenia		Katzev & Swiny 2023
Palestinian/Phoenician-style Egyptian	Egypt	Kyrenia		Katzev & Swiny 2023
Cypriot	Cyprus	Kyrenia		Katzev & Swiny 2023
Kourion	Cyprus	Kyrenia		Katzev & Swiny 2023
Chian	Chios	Tektaş Burnu; Mazotos	-Chios well-known for having high-quality wine	Briggs et al. 2022; Carlson 2003; Carlson 2013; Demesticha 2011
Mendeian	Mende	Tektaş Burnu; Porticello	-Mende known for wine exports	Carlson 2003; Carlson 2013; Eiseman & Ridgway 2012
Northern Aegean	Possibly Lesbos, Thrace, or Peparethos	Tektaş Burnu		Carlson 2003; Carlson 2013
Punic	Northern Africa, around Carthage; possibly Motya, Sicily	Porticello	-Salted meats contained and preserved in transport amphorae considered to be a Punic practice for transporting items	Eiseman & Ridgway 2012; Lawall 2001
West Greek	Unknown	Porticello		Eiseman & Ridgway

				2012
Solokha II (Byzantine)	Pontic Greek (Northeastern Anatolia) (Lawall 2001:535)	Porticello		Eiseman & Ridgway 2012

Ancient shipwrecks like those discussed in this research are often discovered by the finding of amphora mounds on the seabed, “partly or totally visible before any excavation took place” (Secci et al. 2021:2). Often, these mounds are in an oblong or oval shape which allows archaeologists to confirm that the site is the remains of a ship (Secci et al. 2021:2).

2.7 Classical shipwrecks

The data drawn upon in this research comes from four shipwrecks, whose locations are shown in *Figure 1*. Since the discovery of each wreck, archaeologists have examined the materials found and published informative data which has been used in this research. The number of Classical shipwrecks are very few and far between, with it being hypothesized that there are thousands more left undiscovered (Carlson 2016:1) than what is currently known; the quantity of potential shipwrecks from the Classical period would be integral to our understandings of ancient trade, as the quantifiable data can provide insight into the scale of trade during this time. In addition to the limited number of wrecks found, there is a smaller number of those wrecks which have been excavated, studied, and discussed in published works. The wrecks which are discussed in this research are well-known and each has been thoroughly published, making available data which has the potential of contributing to our understanding of trade commodities from the Classical period. Other ancient wrecks, such as Magan Michael wreck and the Alonnesos wreck (Carlson 2016:4), have similar historical contexts to

those discussed in this research; however, they were not included in this analysis because not enough information concerning their cargoes has been published so far.



Figure 1: Map of the Mediterranean Sea with markers of shipwrecks in this research.

2.7.1 Tektaş Burnu (Turkey)

The Tektaş Burnu shipwreck was excavated between 1999 and 2001 by the Institute of Nautical Archaeology at Texas A&M University after being discovered in 1996 (Carlson 2003:581). The wreck has been dated to approximately 440-425 BC. Identified by the excavators as a merchant vessel, it is located on the Turkish coastline, southwest of Sığacık and east of Chios, at a depth of approximately 40 meters (Carlson 2003:581). Initial surveying showed a mound of sixty amphorae, and excavation of the site led to the discovery of many more. In addition to transport amphorae, archaeologists discovered painted pottery wares from eastern Greece, Chios and Attica, assumed to have been intended for trade (Carlson 2003:593), and infrastructural remains of the ship's hull (Carlson 2003:591-595).

2.7.2 Porticello (Italy)

The Porticello wreck was discovered in the Straits of Messina by a fisherman in 1969. The Straits of Messina are located between Italy and Sicily, with the wreck being 225 meters off the coast of the nearby village of Porticello at a depth of 33-37 meters (Eiseman & Ridgway 2012:5). The wreck was heavily looted before authorities intervened in November of that year (Eiseman & Ridgway 2012:4). Archaeologists from the University Museum at the University of Pennsylvania excavated the remains of the wreck and its materials in 1970, identifying the wreck as a former merchant vessel and later dating it to 415-385 BC. In research pertaining to the Porticello wreck, archaeologists often focus on the materials found during excavation, although others were recovered during police investigations. Archaeologists are thus unable to document the complete assemblage of what may have been found at this site. However, the materials they excavated included transport amphorae, lead ingots, inkpots, and pieces of a bronze sculpture.

2.7.3 Mazotos (Cyprus)

Research on the Mazotos shipwreck began in 2007 and continues today. It is located 1.5 nautical miles south of Mazotos, Cyprus, approximately 44 meters below the water's surface (Briggs et al. 2022:781; Demesticha 2011:40). The wreck has been identified by its excavators as the remains of a merchant ship dating approximately to 350-325 BC, based on the chronology of 500 transport amphorae which were visible upon initial surveying of the wreck site (Briggs et al. 2022:781; Demesticha 2011:40). Much of the research into the Mazotos wreck that has been published so far focuses on the many transport amphorae. Therefore, it is not known if other trade commodities have been or remain to be found.

2.7.4 Kyrenia (Cyprus)

The Kyrenia shipwreck was discovered off the northern coast of Cyprus (Katzev & Swiny 2023:42), very near to the city of Kyrenia, in 1967, and later excavated in 1968 and 1969 by the Penn Museum (Katzev & Swiny 2023:39). The wreck has been dated to 325-315 BC, the very end of the Classical period. The wreck is noted to have been found very near to the shore and at a depth of 7-10 meters (Katzev & Swiny 2023:42). Archaeologists identified it as the remains of a merchant vessel, excavating a large number of transport amphorae and other utilitarian wares, as well as 29 grain millstones sitting on the remains of the hull.

2.8 Material evidence from wrecks

The data present here regarding the commodities carried by these ships, which largely come from the analysis of transport amphorae, have been assembled from various studies and published reports from the wreck sites. Evidence will include insight into potential transport amphorae contents, with the contents being identified through macro-remains, organic residue analysis, origins and typologies of amphorae, and the interior lining (or lack thereof) of transport amphorae. Other finds of materials that might have been identified as commodities, not associated with amphorae, will also be noted.

2.8.1 Tektaş Burnu (Turkey)

Table 2: Summary of transport amphorae excavated from Tektaş Burnu wreck (Carlson 2003; Carlson 2013)

Amphora type (geographical origin)	# found at site	Potential contents?
Pseudo-Samian (unknown; possibly Erythrae)	Nearly 200	wine; 1 butchered beef bones
Mendeian (Mende)	10	9 pine tar; 1 butchered beef bones
Chian (Chios)	2	—

Samian (Samos)	3	—
Northern Aegean (Lesbos, Thrace, or Peparethos?)	2	—



Figure 2: Map of Tektaş Burnu shipwreck location and where cargo possibly came from.

The wreck site at Tektaş Burnu was identified by a mound of transport amphorae on the seabed in 1996 (Carlson 2003:581). After three field seasons, which resulted in it being the first Classical wreck to be cully excavated in the Aegean (Carlson 2003:598), archaeologists had recovered approximately 200 transport amphorae. These amphorae were categorized as primarily being Pseudo-Samian in style (Carlson 2003:583), with ten being categorized as Mendeian (Carlson 2003:587), two as Chian, three as Samian, and two as Northern Aegean (possibly from Lesbos, Thrace, or Peparethos) (Carlson 2003:590). As will be discussed below, the Pseudo-Samian amphorae were possibly produced in nearby Erythrae (Carlson 2003:581), meaning the ship either stopped at or came from Erythrae.

The Pseudo-Samian amphorae are thought to have been carrying wine at the time of sinking (Carlson 2013:6). This inference was made because the amphorae were lined with pitch, in which the

occasional grape seed could be seen (Carlson 2013:6). Archaeologists have previously studied grape seeds to identify whether they had been pressed for wine or dried into raisins (Margaritis & Jones 2006:801); however, the seeds from the Tektaş Burnu wreck have not been studied in this manner, so archaeologists consider them to be a marker for wine instead (Carlson 2013:6). Suppose all the Pseudo-Samian amphorae all contained the same contents. In that case, it can be concluded that approximately 90% of the commodities carried in amphorae on the wreck at Tektaş Burnu were wine.

Pseudo-Samian amphorae have not been linked to any one place of manufacture (Carlson 2013:4); they have been found at several excavation sites over the years, including Chios, Miletus, Aegina, Athens, Naucratis, and Cyprus (Carlson 2003:585). One Pseudo-Samian amphora from the Tektaş Burnu wreck included a stamp noted as being Erythraian (Carlson 2003:107; Carlson 2013:6), thus linking the wreck to the ancient city of Erythrae, which is near the wreck site. This leads to the question of whether the ship stopped at or originated from Erythrae, as well as whether Pseudo-Samian amphorae were produced in the region. Archaeologists have concluded that the Pseudo-Samian amphorae from the Tektaş Burnu shipwreck were most likely produced in Erythrae due to the presence of the stamp (Carlson 2003:581; Carlson 2013:6).

Nine of the ten Mendeian amphorae are known to have been carrying pine tar at the time of sinking. The amphorae were discovered still filled with the pitch, ranging in fullness from 40% to 70% (Carlson 2003:589). However, research conducted by Curt Beck of the Amber Research Laboratory at Vassar College has shown that the pine tar was not derived from a species of pine in the Northern Aegean as the containers' style would suggest (Carlson 2013:6); it was not concluded where the pine tar may have come from (Carlson 2013:6). Nevertheless, scholars have noted this being of interest as the "consignment of pine tar in Northern Greek containers" not originating from Northern Greece brings to light questions of whether the place of production for the product mattered (Carlson

2013:6). Furthermore, archaeologists have not concluded whether the pine tar in these amphorae was a trade commodity being transported as cargo, or whether it was carried by the crew to be used to maintain the ship itself for waterproofing or as a sealant.

Two transport amphorae, one Mendeian and one Pseudo-Samian, contained macro-remains of butchered beef bones, which archaeologists conclude to most likely have been part of the supplies for the crew (Carlson 2003:589-590). Archaeologists identified the remains as being caudal vertebrae (Carlson 2003:589) and ribs (Carlson 2006:132), not a more choice cut of meat. Transportation of meat was not unknown for the time, though it was uncommon and considered a Punic practice (Carlson 2003:589). However, as beef was not a staple of the Greek diet and was not usually available to the general public, archaeologists note that there is reason to think the beef bones were part of the ship's cargo for trade (Carlson 2003:590). While its status as a commodity is unlikely and unclear, this research will nevertheless consider the place of beef products in trade during the Classical period.

In addition to the transport amphorae, archaeologists excavated several utilitarian fine wares from the wreck site. Thirteen of these wares were identified as *amphoriskoi* (table amphorae), one was identified as an *askos* (a type of domed pitcher), and four were identified as *olpai* (a type of jug) (Carlson 2013:8), all of which are thought to be East Greek (Carlson 2003:591). An additional 14 *kantharoi* (two-handled drinking cups) were found and identified as being Chian due to their fabric and stylistic design (Carlson 2003:592; Carlson 2013:7). Smaller groups of wares were found throughout the wreck site, such as oil lamps and other dishware. Unlike the transport amphorae, the pottery here was decorated and painted, often in Chian styles (Carlson 2003:592), leading to the assumption that these wares were intended for trade. Supporting this assumption is the excavation of a small assemblage of undecorated coarseware vessels, thought to have been used on board the ship by the crew (Carlson 2003:593).

2.8.2 Porticello (Italy)

Table 3: Summary of transport amphorae excavated from Porticello wreck (Eiseman & Ridgway 2012)

Amphora type (geographical origin)	# found at site	Potential contents?
Mendeian (Mende)	13	wine?
Punic (Carthage? Motya?)	15	salted fish?
West Greek (unknown)	3	---
Solokha II (Byzantine) (Northern Anatolia?)	2	---



Figure 3: Map of Porticello shipwreck location and where cargo possibly came from.

The Porticello shipwreck produced fewer amphorae than other wrecks discussed in this research. Immediately after its discovery in 1969, the wreck was heavily looted by fishermen and divers (Eiseman & Ridgway 2012:3-4). Reports about the transport amphorae from the wreck consider only the ones excavated by the University Museum excavation team of the University of Pennsylvania in 1970; others that probably came from the wreck were recovered in police investigations, but could not be definitively proven as coming from the Porticello wreck (Eiseman &

Ridgway 2012:8). The same considerations will be made here; this also means that the recorded evidence from this wreck site is much smaller than that of the other sites discussed in this research.

The excavations by the University Museum yielded 33 transport amphorae, which were then categorized into four types. Thirteen Mendeian amphorae were discovered, five of which were lined with pitch (Eiseman & Ridgway 2012:37-39). Despite the small quantity, researchers note this as being “the largest single deposit of contemporary amphoras of this type” (Eiseman & Ridgway 2012:41), opening questions of whether this carries significance for where the ship originally came from. Reports from the wreck do not include much discussion or insight regarding what these amphorae carried; however, the city-state Mende was known for its wine exports during the second half of the fifth century BC (Eiseman & Ridgway 2012:40). On that basis, archaeologists infer that wine was possibly carried in these amphorae as a commodity (Eiseman & Ridgway 2012:40-42).

In addition to the Mendeian amphorae, 15 Punic amphorae were excavated and identified. Punic amphorae are noted as being from northern parts of Africa, with links to regions surrounding Carthage (Lawall 2001:535), though they have been found across Europe at archaeological sites (Eiseman & Ridgway 2012:46). Punic amphorae from the Porticello wreck site are also thought to have been produced in Motya, on the west coast of Sicily; however, this theory has not been confirmed (Eiseman & Ridgway 2012:47).

The Punic amphorae are classified into five additional sub-types based on stylistic differences. Two of these types, Type A and B, include a finished hole at the toe of the amphora (Eiseman & Ridgway 2012:42). Other stylistic differences between sub-types are the presence or absence of wheel-markings (Eiseman & Ridgway 2012:43-44) or difference of shape at the base (Eiseman & Ridgway 2012:44). Archaeologists note that the variations present in the assemblage of

Punic amphorae from the Porticello wreck indicates that stylistic changes in amphorae are not always an indicator of functional change over time (Eiseman & Ridgway 2012:47).

Of the Punic amphorae, two Type A amphorae were lined; none of the other amphorae were lined. However, it is unlikely that these lined amphorae carried wines or oils due to the presence of the bottom holes, which have finished edges and are thought to be intentional (Eiseman & Ridgway 2012:47). Stoppers were most likely used to close the hole at the bottom, though excavation yielded no evidence of stoppers, which could have deteriorated over time (Eiseman & Ridgway 2012:47). Some have posited that these amphorae may have carried salted fish as Punic amphorae from other sites have been linked to this practice, though it is impossible to conclude this since the amphorae were cleaned without the watered-contents being sieved for possible macro-remains (Eiseman & Ridgway 2012:48). Archaeologists who support this theory also note that if these amphorae did indeed carry fish products, then there is also the possibility that they carried different variations within different amphorae, as only two of the Punic amphorae were lined and there are also five types of Punic amphorae (Eiseman & Ridgway 2012:48).

Of the remaining five amphorae, three were identified as being of West Greek origin and two as the Solokha II (Byzantine) type (Eiseman & Ridgway 2012:48-50). Of these amphorae, two West Greek amphorae were lined (Eiseman & Ridgway 2012:49). Definitive origins of West Greek amphorae are difficult to place, though they have been found at various archaeological sites across Greece and Italy (Eiseman & Ridgway 2012:49). The Solokha II (Byzantine) amphorae are thought to have originated from Northeastern Anatolia (Lawall 2001:535), Bosphorus, or Byzantium (Eiseman & Ridgway 2012:50). Reports and previous research do not offer indication for what these amphorae may have carried.

The Porticello wreck yielded further evidence of cargo apart from transport amphorae. Two lead ingots are included in the assemblage, though police investigations note that many were sold for scrap by the looters (Eiseman & Ridgway 2012:53). Lead is often discussed more in studies of the Roman era rather than the earlier Greek periods, as ancient writings seldom discuss the product (Eiseman & Ridgway 2012:54). Comparative studies of the lead ingots from the Porticello wreck to those excavated at comparable sites allowed archaeologists to infer that these lead ingots may have come from Sicily, Italy, or Laurion (Attica) (Eiseman & Ridgway 2012:59). In addition to the lead ingots, archaeologists excavated eight undecorated inkpots (Eiseman & Ridgway 2012:60), though archaeologists do not have enough information regarding their possible origins or centers of ink production during this time (Eiseman & Ridgway 2012:62). The final item of cargo excavated were pieces of a life-size bronze statue of a bearded man (Eiseman & Ridgway 2012:63), but the material and style of manufacturing could not be linked to any particular geographical or cultural origin (Eiseman & Ridgway 2012:99-100).

2.8.3 Mazotos (Cyprus)

Table 4: Summary of transport amphorae excavated from Mazotos wreck (Briggs et al. 2022; Demesticha 2011)

Amphora type (geographical origin)	# found at site	Potential contents?
Chios	~500	wine; olive product
Southeastern Aegean	4	—
Northern Aegean (Mende?)	3	—



Figure 4: Map of Mazotos shipwreck location and where cargo possibly came from.

The Mazotos wreck continues to be the subject of *in situ* research, so until the excavation is concluded, it is difficult to know how many transport amphorae this ship carried. However, current estimates place the quantity at approximately 500 transport amphorae (Demesticha 2011:39). These amphorae are largely of Chian origin (Briggs et al. 2022:781), leading to the assumption that these amphorae may have carried wine from Chios since the island was well-known for its production and export of high-quality wine (Briggs et al. 2022:781; Demesticha 2011:48). Less than ten of the excavated amphorae have also been identified as coming from the southeastern Aegean and northern Aegean (possibly Mende) (Katzev & Swiny 2023:379). Many of these amphorae also had pitch lining on the interior walls, consistent with the idea that these amphorae carried wine; however, previous researchers also note that other commodities, such as fish sauces, fruits and olives, may also have been carried in pitch-lined amphorae (Demesticha 2011:48). In the context of the Mazotos wreck, it is largely agreed upon that wine was most likely the primary commodity (Briggs et al. 2022:781; Demesticha 2011:48).

In recent years, transport amphorae from the Mazotos wreck have also been subject to studies for organic residue analysis, bringing forth potential indicators for what organic materials were carried in these amphorae. Organic residue analysis is used to identify organic materials absorbed into the amphorae walls, allowing for the inference or identification of what an amphora may have carried in the absence of macro-remains (Briggs et al. 2022:780). Previous researchers have noted that different substances permeate amphorae with resinous linings differently; for example, wine would permeate a pitch lining easily, allowing for the absorption of organic materials, whereas oils would not have permeated as deeply (Katzev & Swiny 2023:367).

Briggs et al. (2022) sampled ten amphorae from the Mazotos wreck in their study of amphorae contents using organic residue analysis. All of the amphorae from the wreck were Chian amphorae, each categorized as 'wine' vessel (Briggs et al. 2022:782). Of these amphorae, one of them had been found to have contained whole olive pits when excavated (Briggs et al. 2022:781), bringing forth evidence of macro-remains that also contradict assumptions that these Chian amphorae only carried wine. Further evidence of macro-remains were present at the Mazotos wreck site, as the authors note that four amphorae of the recovered 250 at the time of the study contained whole olive pits (Briggs et al. 2022:781). In the results of this study, organic residue analysis yielded evidence for conifer exudates (seven amphorae), grape product (two amphorae), and fruit products (two amphorae) (Briggs et al. 2022:792). The conifer exudate is most likely resulting from the resinous linings of the amphorae, used as a sealant on the interior walls (Briggs et al. 2022:787). While we have seen that pine tar can be found in transport amphorae as a commodity, archaeologists note that intentional lining of amphorae with pine tar leaves a smooth finish to the walls rather than the thicker deposit associated with the carrying of tars (Katzev & Swiny 2023:367). Archaeologists can thus identify whether conifer products were carried as a product or used to line an amphora.

2.8.4 Kyrenia (Cyprus)

Table 5: Summary of transport amphorae excavated from Kyrenia wreck (Katzev & Swiny 2023)

Amphora type (geographical origin)	# found at site	Potential contents?
Rhodian (Rhodes)	340	wine
Samian (Samos)	17	almonds; oils?
Knidian (Knidos)	7	—
Koan (Kos)	4	—
Palestinian or Phoenician-style Egyptian	3	—
Cypriot (Cyprus)	1	—
Kourion (Cyprus)	1	—



Figure 5: Map of Kyrenia shipwreck location and where cargo possibly came from.

Over the course of two field seasons in 1968 and 1969, archaeologists recovered a total of 403 amphorae and amphorae fragments from the Kyrenia wreck site (Katzev & Swiny 2023:89). After conservation in subsequent seasons, this count was reduced to 379 separate amphorae (Katzev & Swiny 2023:89). These amphorae were categorized according to Michael Katzev's working

geographical typology at the time, leading to the conclusion that amphorae at this wreck site came from Rhodes, Knidos, Samos, and Kos, among other broad regions (Katzev & Swiny 2023:278). Of the amphorae recovered during excavation, 340 were classified as Rhodian, 17 as Samian, seven as Knidian, four as Koan, three as Palestinian and Phoenician-style Egyptian, one as possibly Cypriot, one as possibly Kourion, and the remaining six were unidentified (Katzev & Swiny 2023:308).

In examining the Rhodian amphorae, archaeologists determined that they most likely carried wine as a commodity. More than 200 of the Rhodian amphorae from the Kyrenia wreck were lined with pine tar (Katzev & Swiny 2023:367); as previously noted, “pine tar” is often used interchangeably with “pitch” despite the distinction between the two, which may be the case here. Two Rhodian amphorae were also included in the previously discussed organic residue analysis of amphorae by Briggs et al. (2022:792), with the analysis yielding evidence for fruit products and conifer exudates. Due to the amphorae linings and the results from the organic residue analysis, it is most likely that these amphorae carried wines.

Like the Tektaş Burnu wreck, the Kyrenia wreck yielded macro-remains, allowing archaeologists to concretely identify transport amphorae contents. A total of 9556 almonds were excavated from the wreck site (Katzev & Swiny 2023:368). More than 2000 almonds were found across three Samian amphorae (Katzev & Swiny 2023:369), with the remaining 7000 scattered about the stern and bow of the ship, and in 23 Rhodian amphorae (Katzev & Swiny 2023:369).

Archaeologists have noted that the movement of the almonds about the site was the result of octopi constructing dens in the wreck site (Katzev & Swiny 2023:366, 453). Experiments have proven that two of the Samian amphorae could have carried more than 8800 almonds, with a single replica Samian amphora holding 4586 almonds (Katzev & Swiny 2023:451). Archaeologists also theorize that some of the almonds may have been transported in burlap sacks which deteriorated over time

(Katzev & Swiny 2023:453; Whitbread 1995:23). As such, it can be understood that the almonds were not exclusively carried in Samian transport amphora.

Oils were thought to be transported in some Samian amphorae on the Kyrenia wreck. The island of Samos was well-known for its exports of olive oil, having a good reputation for the product (Katzev & Swiny 2023:368). However, there is limited evidence of oil being carried in any amphorae from the site (Katzev & Swiny 2023:368). The study conducted by Briggs et al. (2022) yielded evidence of plant oil from a single Samian amphora which was initially hypothesized to have carried wine; this plant oil was not confirmed as having been from any specific plant (Briggs et al. 2022:792; Katzev & Swiny 2023:368). Furthermore, the Samian and Koan amphorae were not lined with pitch, meaning that they were at the very least unlikely to have carried liquids, including wine and oils (Katzev & Swiny 2023:368).

In addition to the transport amphorae, archaeologists excavated 29 grain millstones located at the lowest layer of the wreck. These millstones are thought to have come from the island of Nisyros in Greece, as evidenced by the dark grey volcanic stone used to cut the stones (Katzev & Swiny 2023:76). As well, the stones are thought to have been used in pairs for grinding down grain (Katzev & Swiny 2023:76), meaning that one of the millstones is missing its partner. No extra millstone was found elsewhere on the wreck, and archaeologists do not know what may have happened to it if it was indeed on the ship at the time of sinking.

2.9 Analysis

From these wrecks, four products have been identified and concluded to have been possible trade commodities that were transported in these ships: wine, (olive) oil products, pine tar, and almonds. Other products, such as salted fish and beef products, will be discussed regarding how they

contribute to our understanding of trade and supply chains in the Classical period, though these products are not definitively evidenced or identified as commodities on the wrecks.

Table 6: Summary of commodities found at each wreck site.

Commodity	Tektaş Burnu	Porticello	Mazotos	Kyrenia
Wine				
(Olive) oil product				
Almonds				
Pine tar				
Salted fish				
Beef				

2.9.1 Wine

It is no surprise that wine is considered here, as it is a well-known commodity of ancient Greece. All four wrecks have evidence of having carried wine in amphorae from Chios (Briggs et al. 2022:781; Carlson 2003:590; Demesticha 2011:41), Mende (Eiseman & Ridgway 2012:40), and Rhodes (Briggs et al. 2022:792; Katzev & Swiny 2023:367). Amphorae transporting wine also made up the bulk of these cargoes, with quantities ranging from 40% to 90% of a wreck’s transport amphorae having some evidence of carrying wine.

Amphorae from the Mazotos wreck are noted as having capacities of approximately 10L to 22L (Katzev & Swiny 2023:379-380). On the Kyrenia wreck, Rhodian amphorae have a capacity of approximately 22L to 28L (Katzev & Swiny 2023:357). Mendeian amphorae from the Porticello wreck carried 19L to 24L (Eiseman & Ridgway 2012:51). Finally, Pseudo-Samian amphorae from the Tektaş Burnu shipwreck had an average capacity of approximately 25L, with one amphorae not being included in this average as it seemed to have been made to a different standard and held

approximately 31L (Carlson 2003:587). Transport amphorae used for carrying wine came in a variety of sizes, though the standards for these sizes seem to fall within a relatively small range, with most amphorae holding between 20L and 30L of cargo.

Table 7: Wine amphora capacity summary.

Amphora type	Shipwreck	Minimum capacity (L)	Maximum capacity (L)	Citation
Chian	Mazotos	9.93	22.00	Katzev & Swiny 2023:379-380
Rhodian	Kyrenia	22.40	28.40	Katzev & Swiny 2023:357
Mendeian	Porticello	19.26	23.93	Eiseman & Ridgway 2012:51
Pseudo-Samian	Tektaş Burnu	<25.12*	31.34	Carlson 2003:587

**Description of minimum capacity of amphorae not found; 25.12L is the known average of this amphora type at this wreck site, meaning that there must be amphorae with a smaller than average capacity*

Archaeologists and historians must question why wine is such a highly valued commodity in the ancient world, as well as why it was transported across different regions of the Mediterranean rather than locally sourced. Surviving written evidence notes that wine was possibly priced based on the perceived quality and its status as local or imported (Katzev & Swiny 2023:373). Price-graffiti also provides insight into potential prices for wines from Chios and Mende, areas considered to have exported high-quality wine, with Chian wine being 4-24 drachms / metretes and Mendeian wine being approximately 3.5 drachms / metretes (Katzev & Swiny 2023:373). The authors note that in the context of price-graffiti, there is no guarantee that the wine being sold in that amphora type is from the amphora type's region (Katzev & Swiny 2023:373). In comparison, evidence for a local wine in the Attic region was priced at 4 drachms / metretes in the fifth and fourth centuries (Katzev & Swiny 2023:374), a very similar price to the imports considered to be "better" in quality.

Wine also holds a place of cultural significance in ancient Greece. Imagery of grapes, grapevines, and the Greek god of wine, Dionysus, are prevalent on coins and decorated amphorae (Katzev & Swiny 2023:367). Nine of the Pseudo-Samian amphorae from the Tektaş Burnu wreck also have a stamp with grape leaves (Carlson 2003:586). Wines were known to have also been gifts between city-states in need, with Rhodes sending 10,000 amphorae of wine to Sinope in 220 BC (Katzev & Swiny 2023:367). Scholars have noted wine as being an indicator of social status, with the higher the quality of wine showing a higher social status (Tzochev 2016:233). As such, wine and grape products have been shown at the very least to have an important role culturally in ancient Greece, which may have contributed to its place as a commodity and export.

2.9.2 Olives/olive oils/plant-based oils

Similar to wine, olives and olive oils are thought to have made up the bulk of trade commodities during the Classical period. Olive oil products were known to have been of better quality from certain regions; for example, Samos was well-known for its production and export of olive oil during ancient times (Katzev & Swiny 2023:368). Olive products were only found to have been present at the Mazotos wreck site (Briggs et al. 2022:781), though there is ongoing debate as to whether some Samian amphorae from the Kyrenia wreck may have carried olive products as well (Katzev & Swiny 2023:368). Olive oil has thus been found in relatively smaller quantities than what may be expected for ancient Greek trade, and it is definitively found much less than wine products.

In ancient times, olive oil would have been a household staple used for many different things. The product was used as a fuel for lamps, providing artificial light to elites and for religious practices (Foxhall 2007:92); oil would have been too costly for lower classes to afford using it for fuel (Foxhall 2007:93). Olive oil was also used for personal hygiene, with use as a soap for bathing being common among both men and women of elite classes (Foxhall 2007:92). Men and boys would also use olive

oil during exercise at the gymnasium (Foxhall 2007:91-92). The oil would sometimes be perfumed (Foxhall 2007:86). As such, it can be inferred that to some extent, the ancient Greek citizens valued their personal hygiene to some extent, with the oil being a large part of their personal care routines.

The most common use for olive oil would have been in cuisine, similar to how it is commonly used in cooking today. Consumption of olive oil for food was common among citizens of ancient Greece regardless of their social status (Foxhall 2007:87), though it was most likely used in larger quantities by the wealthy for hosting others as a show of status (Foxhall 2007:88). Olive oil was a staple of the traditional Mediterranean diet as it provided nutritional value of dietary fat (Lăcătușu et al. 2019:3) and the product had a long shelf life (Uylaşer & Vıldız 2014:1093). Olive oil would have also been in cooking other foods, mostly fish and vegetables (Lăcătușu et al. 2019:3), allowing for a primarily plant-based and pescatarian diet to be followed by the majority of the populace. The consumption of olive oil in conjunction with other hallmarks of the Mediterranean diet is linked to better cardiovascular health (Lăcătușu et al. 2019:4; Uylaşer & Vıldız 2014:1095), leading to research on the benefits of the traditional Mediterranean diet being prevalent in modern health sciences.

Similar to wine, olives had a significant place in ancient Greek culture. Greek mythos states that the goddess of wisdom, Athena, bestowed the gift of the olive tree to the city-state Athens (Uylaşer & Vıldız 2014:1093); the goddess was also depicted on Athenian coins as their patron goddess (Uylaşer & Vıldız 2014:1093) and the olive tree is strongly considered a symbol of Athens (Lăcătușu et al, 2019:2). Victors of the ancient Olympics were also awarded laurels made from olive branches (Uylaşer & Vıldız 2014:1093). Once more, the commodity would have been significant beyond practical, everyday use, being an item which would connect city-states through culture in the Mediterranean.

2.9.3 Pine tar

Pine tar is an incredibly versatile product, being used in ancient times for a variety of things. As previously discussed, pine tar was used to line the interior walls of transport amphorae similar to pitch; the pine tar would act as a waterproofing sealant for the interior walls due to its hydrophobic properties (Hanuš & Ben-Yehoshua 2013:232, 235; Preusz et al. 2019:567). To coat the interior of the amphora, the container would be heated before the resin was put in and liquified, then being turned to evenly coat the whole interior (Preusz et al. 2019:565-566). In addition to sealing the interior of amphorae, pine tar would be used to preserve wood which would be exposed to harsh conditions, such as wood on ships (Barnes & Greive 2017:80), as the pine tar would aid in repelling water and keep the wood in working condition.

In addition to having hydrophobic properties, the chemical composition of pine tar allowed the product to be used for medicinal purposes as well. Written works by Hippocrates (*De prisca medicina* VM 15) prove that pine tar had been used for treating skin ailments, such as eczema and psoriasis, in ancient civilizations (Barnes & Greive 2017:80). Recent studies have found pine tar to be “antipruritic, anti-inflammatory, antiseptic, astringent, keratoplastic, cytostatic, antibacterial and antifungal” (Barnes & Greive 2017:82). Pine tar continues to be found in a variety of products for skin ailment treatments in modern medicine, though coal tar is much more common and more researched (Barnes & Greive 2017:81).

2.9.4 Almonds

Almonds are considered a commodity by archaeologists. Almonds are not referenced in many surviving written records (Katzev & Swiny 2023:369), and very few of these references include a market value price for them (Katzev & Swiny 2023:375). One record, Diocletian’s Edict on Maximum Prices, notes almonds as having cost 6 denarii per xestes; this is compared to the price of

cheap wine, with the exchange rate for this time noting almonds to have cost approximately 3.5 drachms / metretres (Katzev & Swiny 2023:376). Further studies by researchers use this price to estimate the value of the almonds on the Kyrenia wreck. Had the almonds filled all Samian amphorae, the almonds would have been approximately 59.6 drachms total (Katzev & Swiny 2023:376). However, archaeologists have assumed that only two Samian amphorae were used to transport almonds, taking into account the number of almonds excavated in conjunction with the calculated amphora capacities; in this case, the almonds would only been valued at approximately 10.5 drachms total (Katzev & Swiny 2023:376). Regardless of the monetary value, almonds and similar foods play an important role in the traditional Mediterranean diet, which was marked by basic characteristics throughout the Mediterranean basin (Lăcătușu et al. 2019:1).

Almonds are noted as having origins in regions of Asia (Lăcătușu et al. 2019:3), with the almonds being noted for their quality from Naxos and Cyprus (Katzev & Swiny 2023:369). The fact that the Kyrenia shipwreck, found in that general region, had almonds on it, might indicate that the ship had taken them on board not long before sinking. Nuts were largely consumed alongside fish, grain and fruit products (Lăcătușu et al. 2019:3), leading to the diet to be primarily pescatarian. Non-seafood products were consumed in much lower frequencies (Lăcătușu et al. 2019:3). As the diet in the Mediterranean basin relied heavily on high-fat and high-calorie substances, such as almonds (Lăcătușu et al. 2019:4), it would be integral to include nuts in trade practices, ensuring that populations could access the products not locally available. Other nut products, such as tiger nuts (Lăcătușu et al. 2019:3), were found in regions of the Mediterranean, so other nut types were possibly available locally to some; nevertheless, it must be considered that some areas did not have local access to such products and thus relied on trading for them.

2.9.5 Other possibilities

2.9.5.1 Salted Fish

Just as almonds are a staple of the traditional Mediterranean diet, so are fish products. While it is understood that any fish was consumed, it seems that fatty fish, such as tuna, were preferable (Preusz et al. 2019:568), contributing to the high-fat concentration of the diet. Fish consumption accounted for most of the protein intake in the ancient world (Herodotus, *The Histories* 1.200; O'Neill Jr. 1938), as other meats were more difficult to come by (see below: Beef Product).

As previously stated, it is not confirmed whether the Punic amphorae from the Porticello wreck carried salted fish (Eiseman & Ridgway 2012:48), though they would not be the only amphorae thought to have carried such a product. In the later Roman era, Punic amphorae from Spain were found to have contained pickled fish, garum (fish sauce; Preusz et al. 2019:568), or oysters (Eiseman & Ridgway 2012:48). Other shipwrecks, such as the Giens shipwreck (75-60 BC), have been found carrying garum in Punic amphorae (Eiseman & Ridgway 2012:48). Punic amphorae have also been excavated at archaeological sites theorized to have been fish-salting establishments (Eiseman & Ridgway 2012:48). As such, there is a strong association between the presence of fish products with Punic amphorae in the archaeological record; the presence of garum on the Giens wreck also confirms the presence of such products at sea, supporting theories of fish products being a commodity in ancient supply chains.

2.9.5.2 Beef Product

Unlike fish products, excavations of Classical shipwrecks yielded concrete evidence of beef products through the macro-remains found at the Tektaş Burnu wreck site, specifically the vertebrae of a cow (Carlson 2003:589). Scholars note that beef products were not a staple of the Mediterranean diet, being available to the general population during public religious festivals with large-scale animal

sacrifices (Carlson 2003:590); it can be inferred that it would have been more available to elite classes as red meats were more expensive and generally limited in consumption (Lăcătușu et al. 2019:1). Archaeologists have noted that the vertebrae most likely would have been used in cooking a stew or soup (Carlson 2003:589). Writings by Herodotus note that Egyptian priests would eat beef and goose brought to them “in great abundance,” and they would never eat fish (Herodotus, *The Histories* 2.37). While there is a particular cultural context to Herodotus’s statement, it nevertheless proves that there were instances where people would primarily rely on beef and other non-fish meat products for their protein intake.

There has not been much discussion in anthropological or historical studies regarding the status of beef as a commodity, though the presence of beef on the merchant ship contributes to understandings of preservation methods of meat products being used in maritime transportation of said products (Carlson 2003:590). As such, archaeologists must consider that these methods were used to transport commodities and not just stores for the crew, regardless of whether the butchered beef bones at the Tektaş Burnu wreck site were a commodity or not.

2.10 Discussion

Four Classical merchant shipwrecks were examined with reference to commodities moved in transport amphorae. These wrecks have provided evidence of many commodities involved in maritime trade, such as wine and olive products, but also seldom discussed items like almonds, pine tar, salted fish and beef products (Briggs et al. 2022:792; Carlson 2003:583, 588, 590; Carlson 2013:4; Demesticha 2011:48; Eiseman & Ridgway 2012:48; Katzev & Swiny 2023:366-370). These commodities were essential to day-to-day life in the Mediterranean, contributing to the traditional diet throughout the region (Lăcătușu et al. 2019:2-3), medical practices (Barnes & Greive 2017:80), and for crafting purposes (Barnes & Grieve 2017:80; Hanuš & Ben-Yehoshua 2013:232, 235; Preusz et

al. 2019:567) in this period. It has also been exemplified that some of these products may have been more available in certain contexts, such as in transporting large quantities of wine as gifts between city-states (Katzev & Swiny 2023:367), or beef products only being available to the general population during festivities involving animal sacrifice (Carlson 2003:590); these contexts allow for an understanding of the cultural significance of these products in relation to their status as commodities.

The question of why trade occurred was posed numerous times in this research; other scholars have given potential answers to this question. It is largely agreed upon that trade was essential for the economy during the Classical period, as accessibility to certain items would have been limited by what was locally available (Lăcătușu et al. 2019:3; Lawall 2016:260; Ulyaşer & Yıldız 2014:1098). Some items were not traded due to lack of accessibility, however; instead, they were included in trade due to their cultural significance. Such is the case with wine, which has been found to be available across Classical Greece (Bresson 2016:165) yet was found in abundance as a commodity upon these four shipwrecks. The product was incredibly culturally significant, which is known from iconography (Katzev & Swiny 2023:367), amphora stamps (Carlson 2003:586), and surviving writings (Maccius Plautus, *Curculio* 1.1.78, *Poenulus* 3.3.85). As trade was previously acknowledged as being a means of facilitating and maintaining social relationships between groups (Agbe-Davies & Bauer 2010:19; Bauer & Agbe-Davies 2010:41), it is not surprising that a relatively common product that held cultural significance was traded so frequently.

Supply chains in the Classical period seem to have been quite vast, with the complete assemblages of these four wrecks ranging from 200 (Carlson 2003:583; Carlson 2013:4) to 500 (Briggs et al. 2022:781; Demesticha 2011:40) amphorae being transported. On average, 60-70% of the transport amphorae of these shipwrecks carried wine, as inferred by archaeologists. While wine

makes up the majority of commodities found within transport amphorae, thus being essential to supply chains during the Classical period, we must further engage with other commodities involved in trade at this time, such as nuts and tar products, as they offer insight into why some items were vital to trading practices as they were not native to certain parts of the Mediterranean.

The analysis of these commodities brings forth an understanding that supply chains and market exchange are essential to the function of society, as well as that they are inherently vulnerable to disruption regardless of historical context (Hoffer 2015:8). Researching trade across historical contexts allows for the understanding of forms of exchange as a means of stimulating economies and establishing social relationships. Long-distance trade is not a modern or post-industrial phenomenon, and it should be treated as such in anthropological research.

This research provides an example of how trade benefits from being examined through an anthropological lens. As a whole, anthropology asks questions about trading systems and practices, which has been seen in the works of Malinowski and Mauss. Anthropological research has noted the non-economic contributions of trade in social relationships and cultural ties. In *Argonauts of the Western Pacific*, Malinowski closes his work by describing kula as “half commercial, half ceremonial exchange, it is carried out for its own sake, in fulfillment of a deep desire to possess” (Malinowski 1922:820); kula carries its economic purposes but does so alongside the social purposes of the trading practice. The same can be seen with the findings of this archaeological research. In analyzing the ways people in Classical Greece used the commodities identified from these four shipwrecks, this research finds that some of these products were involved in trade as culturally significant items, such as wine and olive products (Carlson 2003:586; Katzev & Swiny 2023:367; Lăcătușu et al. 2019:2; Tzochev 2016:233; Uylaşer & Yıldız 2014:1093), as we have previously discussed. In archaeological research of trade, there must be a focus on the formalized market exchange; however, these social and

cultural components of why some products are involved in trade cannot be ignored. Archaeologists must employ their unique position of looking to material remains to expand our knowledge of trading practices as both an economic and a social phenomenon.

Examining shipwrecks in the context of supply chains must be further engaged with in archaeological research with an anthropological lens. We have acknowledged that shipwrecks provide insight into trade as it happens; they do not have the limitations of examining trade only before or after the event. The shipwrecks discussed in this research have had their cargo identified in previous archaeological studies (Briggs et al. 2022; Carlson 2003; Carlson 2013; Demesticha 2011; Katzev & Swiny 2023), if not plausibly theorized by archaeologists in their research (Eiseman & Ridgway 2012); the evidence obtained from these wrecks makes the sites apt for broader case studies of trade and commodities from this historical period.

Analysis of ancient shipwrecks will provide more knowledge of how trade functioned during this time through contextual evidence (Greene 2018:133; Katzev & Swiny 2023:76), which is integral to the overall understanding of trade as part of human societies. Such analysis can open discussion for future research on trade, especially with commodities other than wine and olive products, which are often shelved in archaeological studies of shipwreck cargo. Analysis of quantitative data can also provide the tools to estimate the actual quantities of these commodities transported by merchant ships, thus providing further insight into the magnitude of supply chains and trading practices of the Classical period.

The essentiality of trade in the Classical period cannot be understated, and maritime archaeology and studies of shipwrecks allows for the best understanding of what items were part of trade and why. However, there is still much to be learned about maritime mobility from this period, as few Classical shipwrecks have been studied to answer all current research questions. Studies of the

ultimate scale of trade must be considered in future research; were the shipwrecks discussed here traveling as a single ship, or is it possible that merchant ships traveled in fleets? If so, how big would these fleets have been? How often would merchant ships go on trade expeditions? How would the cargo of ships from other periods, either earlier or later, compare to those we have seen from the Classical period? There are a number of unanswered questions regarding studies of antiquity and maritime trade, and while it is unknown whether archaeologists will concretely answer such questions, they must still be considered in the broader scope of maritime archaeological research of trade.

Many possible avenues for future research exist and are open for analysis. We have only discussed the cargo transported in transport amphorae upon these ships, yet there are still a number of other commodities to be analyzed and discussed in the context of answering questions of trade. Why were grain millstones, lead ingots, inkpots, and pottery wares involved in trade? Were the materials or potential alternatives not available in certain regions? What would they have been used for, and by who? Questions which have been considered in this research with reference to the transport amphorae contents can be applied to the other commodities found on these four shipwrecks, and they must be considered in future research into trade of the Classical period.

Despite the insight given to commodities in this research, there are nevertheless limitations to what can be identified and discussed. All data from these wreck sites have been taken from published works of site reports and previous studies conducted with respect to these shipwrecks. Unfortunately, not all data from an archaeological site is published. There is the risk that data could be missing from these reports and previous studies, which thus impacts the interpretations made in this research. There is also the risk that some published materials may be difficult to find or access, and thus were not included in this research due to these unknown or impassable barriers. Furthermore, research

continues to be ongoing in archaeology as data becomes available; as such, inferences made in this research may be contradicted in the future as more information becomes available to archaeologists.

In addition to potential missing data from the wrecks themselves, the research is also impacted by the broader missing data within maritime archaeological research on ancient shipwrecks. Less than 2000 ancient wreck sites have been identified, with even fewer being studied in maritime archaeology (Carlson 2016:1). It is impossible to gauge how many ancient shipwrecks exist and are in conditions that would allow for extensive research, with the only way to gain this information being to survey the whole of the seafloor of the Mediterranean. Furthermore, the information we do have regarding maritime trade comes only from the ships that never completed their journey; the information from those that never became potential archaeological sites will never be available to us. We do not know whether the sample procured in previous research with the known shipwrecks paints an accurate picture of what trade looked like during the Classical period and beyond, thus limiting how much can actually be known about the topic.

A final limitation for this research would be the limited evidence regarding some of the commodities discussed in this research. While archaeologists have presented an abundance of evidence regarding wine production and trade (Margaritis & Jones 2006; Katzev & Swiny 2023:367-368, 373-374), the same cannot be said for some of the other items. For example, almonds are not noted in many surviving written records (Katzev & Swiny 2023:375), thus limiting our knowledge of their value as a commodity and their place within trade as a whole. Limited evidence can also result from limited research on the excavated items themselves. Limited research has been conducted on the Porticello wreck in recent years, though there are still a number of questions that archaeologists can and should explore; for example, is there any way for us to conclude if the Punic amphorae from this wreck did carry salted fish? Or are there other products that could have been carried in these

amphorae? Similarly, in the case of the Tektaş Burnu shipwreck, is there more that can be done to identify whether the beef bones were conclusively a commodity or not? These are hypotheses which are unresolved yet are not discussed further in currently published archaeological research, leading to a large gap in the existing literature on these specific commodities.

Trade continues to be an ongoing event in the world, and it will most likely never cease to be. While disruptions have occurred and will continue to occur, such as the COVID-19 pandemic, the Suez Canal obstruction, the Russia-Ukraine War, and of course, the sinking of these four merchant vessels, there is a resiliency that exists in supply chains and globalization. However, as unanticipated as disruptions to supply chains and trade may be, there is nevertheless a responsibility to examine how and why such disruptions occur and to learn from the global or regional responses to these events.

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